

## Feature Section ... Hurricanes and Tropical Storms

### *Introduction to Hurricane Season 2002*

The Atlantic hurricane season officially began on June 1<sup>st</sup>, and the season is off to a fairly typical quiet start.

The latest hurricane season forecast from NOAA is for normal to slightly above normal tropical activity, meaning there may be 9 to 13 named tropical storms. 6 to 8 of those storms may reach hurricane strength, 2 or 3 of which may become major hurricanes. (A major hurricane is defined as Saffir-Simpson category 3 or higher).

For comparison, a "normal" season consists of 10 named tropical storms, 6 hurricanes and 2 major hurricanes. Dr. William Gray, a hurricane researcher at Colorado State University, and his team of forecasters are predicting 11 named storms, 6 hurricanes and 2 major hurricanes.

Please keep in mind that in the past 15 to 20 years, we have had very few "direct hits" by full-blown hurricanes in the Tri-State Region. In addition, only a few weak tropical storms have even brushed the area. Tropical Storm Floyd was certainly an exception to that in 1999 (more later).

In the sections below, we'll delve into some tropical terminology, climatology, and preparedness information. Thanks to NOAA's National Hurricane Center (NHC) for much of this information.

### *Terminology*

Here are some of the terms you may hear regarding tropical weather.

**Hurricane Season:** The portion of the year having a relatively high incidence of hurricanes. The hurricane season in the Atlantic, Caribbean, and Gulf of Mexico runs from June 1 to November 30.

**Tropical Cyclone:** A warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center. Once formed, a tropical cyclone is maintained by the extraction of heat energy from the ocean at high temperature and heat export at the low temperatures of the upper troposphere.

**Tropical Wave:** A trough or cyclonic curvature maximum in the trade-wind easterlies. The wave may reach maximum amplitude in the lower middle troposphere.

**Tropical Disturbance:** A discrete tropical weather system of apparently organized convection, generally 100-300 miles in diameter, originating in the tropics or subtropics, having a nonfrontal migratory character, and maintaining its identity for 24 hours or more.

**Tropical Depression:** A tropical cyclone in which the maximum sustained surface wind speed is 33 kt (38 mph) or less.

**Tropical Storm:** A tropical cyclone in which the maximum sustained surface wind speed ranges from 34 kt (39 mph or 63 km/hr) to 63 kt (73 mph).

**Tropical Storm Watch:** An announcement for specific coastal areas that tropical storm conditions are possible within 36 hours.

**Tropical Storm Warning:** A warning that sustained winds within the range of 34 to 63 kt (39 to 73 mph) associated with a tropical cyclone are expected in a specified coastal area within 24 hours or less.

**Hurricane:** A tropical cyclone in which the maximum sustained surface wind is 64 kt (74 mph) or more. The term hurricane is used for Northern Hemisphere tropical cyclones east of the International Dateline to the Greenwich Meridian.

**Hurricane Watch:** An announcement for specific coastal areas that hurricane conditions are possible within 36 hours.

**Hurricane Warning:** A warning that sustained winds 64 kt (74 mph) or higher associated with a hurricane are expected in a specified coastal area in 24 hours or less. A hurricane warning can remain in effect when dangerously high water or a combination of dangerously high water and exceptionally high waves continue, even though winds may be less than hurricane force.

**Extratropical:** A term used in advisories and tropical summaries to indicate that a cyclone has lost its "tropical" characteristics. The term implies both poleward displacement of the cyclone and the conversion of the cyclone's primary energy source from the release of latent heat of condensation to baroclinic (the temperature contrast between warm and cold air masses) processes. It is important to note that cyclones can become extratropical and still retain winds of hurricane or tropical storm force.

**Eye:** The roughly circular area of comparatively light winds that encompasses the center of a severe tropical cyclone. The eye is either completely or partially surrounded by the eyewall cloud.

**Eyewall:** An organized band or ring of cumulonimbus clouds that surround the eye, or light-wind center of a tropical cyclone.

**Inland High Wind Watch for Hurricane (Or Tropical Storm) Force Winds:** Issued by your local NWS office, usually in conjunction with a Hurricane (Tropical Storm) Watch issued by the National Hurricane Center, when hurricane (tropical storm) force winds are possible for inland/non-coastal counties.

**Inland High Wind Warning for Hurricane (Or Tropical Storm) Force Winds:** Issued by your local NWS office, usually in conjunction with a Hurricane (Tropical Storm) Warning issued by the National Hurricane Center, when hurricane (tropical storm) force winds are expected for inland/non-coastal counties.

**Hurricane Local Statement:** A public release prepared by your local NWS office in or near a threatened area giving specific details for its county warning area on weather conditions, evacuation decisions made by local officials, and other precautions necessary to protect life and property.

For more terminology, go the NHC web site. The web address will be listed at the end of the newsletter.

## Saffir-Simpson Scale

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf in the landfall region.

**Category One Hurricane:** Winds 74-95 mph (64-82 kt). Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage.

*Hurricanes Allison (1995) and Danny (1997) were Category 1 hurricanes at peak intensity.*

**Category Two Hurricane:** Winds 96-110 mph (83-95 kt). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings.

*In 1998, Hurricane Bonnie was a Category 2 hurricane when it hit the North Carolina coast. Hurricane Georges was a Category 2 Hurricane when it hit the Florida Keys and the Mississippi Gulf Coast.*

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**Category Three Hurricane:** Winds 111-130 mph (96-113 kt). Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the hurricane center. Flooding near the coast destroys smaller structures with larger structures damaged by battering of floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles or more. Evacuation of low-lying residences within several blocks of the shoreline may be required.

*Hurricanes Roxanne (1995) and Fran (1996) were both Category 3 hurricanes at landfall on the Yucatan Peninsula and in North Carolina, respectively.*

**Category Four Hurricane:** Winds 131-155 mph (114-135 kt). Storm surge generally 13-18 ft above normal. More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the hurricane center. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles.

*In 1995, Hurricane Luis was a Category 4 hurricane while moving over the Leeward Islands. Hurricanes Felix and Opal also reached Category 4 status at peak intensity.*

**Category Five Hurricane:** Winds greater than 155 mph (135 kt). Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the hurricane center. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles of the shoreline may be required.

*Hurricane Mitch (1998) was a Category 5 hurricane at peak intensity over the western Caribbean. Hurricane Gilbert (1988) was a Category 5 hurricane at peak intensity and is the strongest Atlantic tropical cyclone of record.*

## Hurricane Threats

The threats from hurricanes aren't just from the wind. Storm surges, storm tides, heavy rains/flooding and tornadoes are additional hazards produced by hurricanes, all of which can be deadly. Flooding inland and away from the center of the storm can be just as devastating as direct hurricane effects near the coast. Again, refer to Tropical Storm Floyd in New Jersey and New York for proof of this.

**Storm surge** is a large dome of water often 50 to 100 miles wide that sweeps across the coastline near where a hurricane makes landfall. The surge of high water topped by waves is devastating. The stronger the hurricane and the shallower the offshore water, the higher the surge will be. Along the immediate coast, storm surge is the greatest threat to life and property.

**Storm tide** is the combination of the storm surge and the astronomical tide. If the storm surge arrives at high tide, the water height will be even greater. For example, as a hurricane moves ashore, a 15-foot surge added to the 2-foot high tide creates a storm tide of 17 feet. This mound of water, topped by battering waves, moves ashore along an area of the coastline as much as 100 miles wide. The combination of the storm surge, battering waves and high winds is deadly and can cause great property damage.

**Hurricane-force winds** can destroy buildings and mobile homes. Debris, such as signs, roofing material, siding, and small items left outside, become flying missiles in hurricanes. Winds can stay above hurricane strength well inland. Hurricane Hugo (1989) battered Charlotte, North Carolina, about 175 miles inland, with gusts to near 100 mph, downing trees and power lines.

Hurricanes and tropical storms also produce **tornadoes**. These tornadoes most often occur in thunderstorms embedded in rain bands well away from the center of the hurricane. However, they can also occur near the eyewall. Usually, tornadoes produced by tropical cyclones are relatively weak and short-lived, but still pose a threat.

**Inland flooding:** All tropical cyclones can produce widespread torrential rains often in excess of 6 inches. This rain can produce deadly and destructive floods. Heavy rain can trigger landslides and mud slides, especially in mountainous regions. Flooding is the major threat from tropical cyclones to people well inland.

Flash flooding, a rapid rise in water levels, can occur quickly due to intense rainfall. Longer term flooding on rivers and streams can persist for several days after the storm. Intense rainfall is not directly related to the winds of tropical cyclones but rather to the speed of movement and geography of the area affected. Slower moving storms produce more rainfall. Mountainous terrain enhances rainfall from a tropical cyclone. Inland flooding can be a major threat to people hundreds of miles from the coast.

## *2002 Atlantic Hurricane Names*

Arthur, Bertha, Cristobal, Dolly, Edouard, Fay, Gustav, Hanna, Isidore, Josephine, Kyle, Lili, Marco, Nana, Omar, Paloma, Rene, Sally, Teddy, Vicky, Wilfred.

## *Local Hurricane and Tropical Storm Climatology*

The Tri-State Region has been spared from a lot of tropical cyclone activity during the past 15 years or so. There have been a number of close calls and near misses, but the only “direct hits” in recent memory have been Hurricane Gloria in September of 1985, and Hurricane Bob in August of 1991.

Hurricane Floyd (September 1999) began as a tropical wave that moved off Africa and made the trek across the Atlantic. After reaching hurricane strength and moving through the Bahamas, Floyd took aim at the Carolinas, making landfall near Cape Fear, NC, on September 16<sup>th</sup>. Floyd weakened to a tropical storm as it moved along the coast through New Jersey, across Long Island and into southern New England.

One of the things that made Floyd such a prolific rainmaker was an old, stalled frontal system, extending from northern New Jersey into northwestern Connecticut and central New England. If you remember from your Skywarn training, fronts are one of the possible lifting mechanisms for thunderstorm development. Well, the same holds true for heavy rainfall. Combine this lifting mechanism with an influx of deep tropical moisture, and you’re setting the stage for excessive rainfall amounts and widespread flooding, which is exactly what happened.

A band of rainfall of 8 to 14 inches extended across much of northern New Jersey into the Lower Hudson Valley. So remember, just because you’re not in the direct path of a hurricane, or the approaching storm is “only” a tropical storm, don’t let your guard down. There are plenty of other hazards to be concerned with, and they all can be deadly!

### *Preparedness Information*

Here are some things to keep in mind when a tropical storm or hurricane approaches.

**Stay informed!** NOAA Weather Radio (NWR) is the official voice of the National Weather Service. 24 hours a day, 7 days a week, NWR broadcasts the latest forecasts, watches and warnings.

Many weather radios are equipped with special alarm tones that sound an alert when the NWS issues certain watches or warnings. Routine programming is interrupted when severe weather is approaching or is imminent, including tropical cyclone threats.

#### **Before the threat of a tropical cyclone even exists...**

- Know the risks of your area. For example, do you live in a potential flood zone?
- Learn safe routes inland.
- Know where official shelters will be located.
- Develop a family hurricane plan.
- Make sure your emergency equipment is in working order (i.e. flashlights, battery-powered radios).
- Make sure you have enough non-perishable food and water supplies on hand.

#### **Before the Storm...**

- Frequently listen to radio, TV or NOAA Weather Radio for the latest information on the storm's progress.
- Fuel and service the family vehicles.
- Have extra cash on hand.
- Stock up on food and water supplies, first aid, supplies and medications, and check batteries.
- Move light weight objects such as garbage cans and toys inside.
- Plan to leave if you live in a mobile home, live on the coastline, offshore island, in a flood plain, or in a high-rise building.

#### **During the Storm...**

- Listen closely to radio, TV or NOAA Weather Radio for official bulletins.
- Complete all preparation activities as soon as possible.
- Leave immediately if local officials tell you to!
- If leaving, notify neighbors and family members outside of the warned area of your plans.
- Take pets with you.
- If in a flood prone area, move to a safe area before you are cut off by flood waters.
- If staying in a home, turn the refrigerator to its coldest setting and keep closed, and turn off utilities if told to do so by authorities. Turn off propane tanks, unplug small appliances. Fill bathtub and large containers with water for sanitary purposes.
- In strong winds...stay away from windows. Take refuge in a small interior room, closet or hallway, and on the first or second floor if in a multiple story building.

#### **After the Storm...**

- Listen closely to radio, TV or NOAA Weather Radio for official bulletins.
- Wait until an area is declared safe before entering.
- **DO NOT ATTEMPT TO DRIVE THROUGH FLOWING WATER!**
- Have professionals check gas, water and electrical lines and appliances for damage.
- Use a flashlight for emergency lighting. Never use candles or other open flames indoors.
- Use tap water for drinking and cooking **ONLY** when told by local officials it is safe to do so.
- Telephones...use for emergencies only.

For more information on hurricane preparedness, see the preparedness web sites listed at the end of the newsletter, including those from the National Hurricane Center and the Upton NY NWS Office.